CLAIMS

What is claimed is:

1. An apparatus for non-electrophoretic determination of the presence of at least one analyte in each of n flowable samples, said apparatus comprising:

a housing having a cavity formed therein;

n filtrate-receiving vessels positioned within the cavity of said housing;

n membrane components, each of said membrane components being positioned in association with one of said filtrate-receiving vessels;

n sample-receiving wells, each of said sample-receiving wells being positioned in association with one of said membrane components such that sample placed within a particular sample receiving well may be caused to filter through the associated membrane component, and a filtrate which emerges from that membrane component will be received within the associated filtrate-receiving vessel;

a lid for sealing each of said sample receiving vessels and said cavity of said housing;

a differential pressure source to cause a pressure differential between each of said sample-receiving wells and each of said filtrate-receiving vessels, said pressure differential being operative to drive each sample through the associated membrane component and the resultant filtrate into the associated filtrate-receiving vessel.

2. The apparatus of Claim 1 wherein said pressure source provides negative pressure within the cavity of said housing so as to pull the filtrate through each membrane component.

3. The apparatus of Claim 1 wherein said pressure source provides positive pressure within the sample wells so as to push the filtrate through each membrane component.

4. The apparatus of Claim 2 further comprising:

n air-inlet openings formed in said apparatus, one of said air inlet openings being associated with each one of said sample-receiving wells, such that when a particular sample-receiving well becomes empty air will be drawn through the associated air inlet opening.

5. The apparatus of Claim 1 wherein the differential pressure source comprises a pump which is integral of the test apparatus.

6. The apparatus of Claim 5 wherein said pump integral of the apparatus is a vacuum pump which is incorporated within said housing.

7. The apparatus of Claim 1 wherein at least some of said membrane components have portions formed of a first hard material, and portions formed of a second elastomeric material, the portions formed of said elastomeric material being at locations which abut against neighboring components of the apparatus to provide substantially air tight sealing therebetween.

8. The apparatus of Claim 7 wherein said first and second materials are co-molded by shooting both said first and second materials into a single mold.

9. The apparatus of Claim 1 wherein said membrane modules are plate-type membrane modules having a plurality of discrete sample flow openings formed therein with membranes being disposed transversely within each such sample flow opening.

10. The apparatus of Claim 1 wherein said membrane modules are individual membrane modules, each having a single sample flow opening formed therein with a membrane positioned transversely within said sample flow opening.

11. The apparatus of Claim 9 wherein at least some of the plate-type membrane modules are provided with engagement members whereby they may be selectively engaged to and disengaged from a neighboring membrane module of other adjacent component of the apparatus.

12. The apparatus of Claim 11 wherein said engagement members comprise latches and corresponding latch engagement notches.

13. The apparatus of Claim 10 wherein at least some of the individual membrane modules are provided with engagement members whereby they may be selectively engaged to and disengaged from a neighboring membrane module of other adjacent component of the apparatus.

14. The apparatus of Claim 13 wherein said engagement members comprise projections and corresponding projection-receiving slots for bayonet-type connection.

15. The apparatus of Claim 13 wherein said engagement members comprise helical threads for screw-type connection.

16. The apparatus of Claim 9 where in at least some of the plate-type membrane modules have orientation restricting registry surfaces formed theron to deter stacking of the membrane modules in incorrect orientation.

17. The apparatus of Claim 9 where in at least some of the plate-type membrane modules have handles formed theron to facilitate grasping and separation of the membrane modules.

18. A system for non-electrophoretic determination of at least a first analyte contained within a matrix, said system comprising:

a first membrane module having a membrane which is operative to prevent some of the matter of said matrix from passing therethrough, while allowing a filtrate containing said first analyte to pass therethrough;

a first vessel positioned in relation to said first membrane so as to receive said filtrate therein; and,

at least one reagent which is combinable with said filtrate in said receiving vessel to provide a reagent-filtrate admixture containing said first analyte and from which said first analyte may be determined.

19. The system of Claim 18 for detection of first and second analytes present within said matrix, said system further comprising:

a second membrane module interposed between said first membrane module and said first receiving well, said second membrane having a membrane which will capture and hold said second analyte while allowing a sub-filtrate containing said first analyte to pass therethrough and into said first receiving well;

a second receiving vessel which is positioned in relation to said second membrane after said second analyte has been captured on said second membrane, such that said second analyte may be eluted from said second membrane to provide an eluant which contains said second analyte, within said second vessel;

at least one second reagent which is combinable with the eluant in said second vessel to provide a reagent-eluant admixture from which said second analyte may be determined.

20. The system of Claim 19 further for determination of first, second and third analytes present within said matrix, said system further comprising:

a third membrane module initially interposed between said second membrane module and said first vessel, said third membrane module having a third membrane which will capture said third analyte from the sub-filtrate

which has passed through said second membrane such that a sub-filtrate containing said first analyte will be received in said first receiving vessel;

a third receiving vessel which is positioned in relation to said third membrane after said third analyte has been captured on said third membrane, such that said third analyte may be eluted from said third membrane to provide an eluant which contains said third analyte, within said third vessel;

at least one second reagent which is combinable with the eluant in said third vessel to provide a reagent-eluant admixture from which said third analyte may be determined.

21. The system of Claim 22 for determination of n analytes contained in said matrix, said system further comprising:

n membranes interposed in series between said third membrane and said first receiving well, each of said n membranes being operative to capture and hold one of said n additional analytes while allowing a sub-sub-filtrate containing said first analyte to pass into said first receiving well;

n receiving vessels which are separately positioned in relation to each of said n membranes after said n analytes have been captured on said n membranes, such that said n analytes may be eluted from said n membranes to provide, within each of said n vessels, an eluant which contains at least one of said n analytes,;

at least one reagent which is combinable with the eluant in each of said n vessels to provide n reagent-eluant admixtures from which each of said n analytes may be determined.

22. The system Claim 18 for use in determining at least one sub-detectable analyte which is present in said matrix at a concentration which is less than the desired concentration for the intended determination of said analyte, said system further comprising:

an analyte-concentrating membrane module having a membrane which will capture said sub-dectable analyte while allowing a sub-filtrate which is substantially free of said sub-detectable analyte to pass into said vessel;

a sub-detectable analyte receiving vessel which is positioned in relation to said analyte-concentrating membrane after said sub-detectable analyte has been captured on said analyte concentrating membrane, such that said sub-detectable analyte may be eluted from said analyte concentrating membrane to provide an eluant which contains said sub-detectable analyte at a concentration which is suitable for detection, within said sub-detectable analyte receiving vessel;

at least one reagent which is combinable with the eluant in said sub-detectable analyte receiving vessel to permit determination of the sub-detectable analyte in the eluant-sub-detectable analyte admixture.

23. The system of Claim 18 wherein said first analyte is free fatty acid, and wherein:

said first membrane comprises a microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing free fatty acids to pass therethrough in said filtrate; and,

said reagent comprises xylenol orange, thereby providing a xylenol orange-filtrate admixture in said first vessel, free fatty acid being determinable within said xylenol orange-filtrate admixture.

24. The system of Claim 18 wherein said first analyte is free fatty acid and wherein the sample is subjected to stress prior to free fatty acid determination, and wherein:

said system further comprises a stress reagent which is combinable with a sample of the matrix to promote the formation of free fatty acids therein;

said first membrane comprises a microporous membrane which will prevent a portion of said stressed matrix from passing therethrough, while allowing the free fatty acids to pass therethrough in said filtrate; and,

said reagent comprises xylenol orange, thereby providing a xylenol orange-filtrate admixture in said first vessel, free fatty acid being determinable within said xylenol orange-filtrate admixture.

25. The system of Claim 18 wherein said first analyte is lipid peroxide and wherein the sample is subjected to stress prior to lipid peroxide determination, and wherein:

said system further comprises a stress reagent which is combinable with a sample of the matrix to promote the formation of lipid peroxides therein;

said first membrane comprises a microporous membrane which will prevent a portion of said stressed matrix from passing therethrough, while allowing the free fatty acids to pass therethrough in said filtrate; and,

said reagent is selected from the group of reagents consisting of:

xylenol orange with acidified iron: and,

reduced hemoglobin;

said second reagent being combinable with the filtrate in the first vessel to provide a reagent-filtrate admixture from which lipid peroxides may be determined.

26. The system of Claim 18 wherein said first analyte is polyphenol, and wherein:

said first membrane comprises a microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing free fatty acids to pass therethrough in said filtrate; and,

said reagent comprises folin ciocalteau, thereby providing a folin ciocalteau-filtrate admixture in said first vessel, polyphenols being determinable within said folin ciocalteau-filtrate admixture.

27. The system of Claim 22 wherein said analyte is histamine, and wherein:

the system further comprises a preliminary membrane which will capture and remove metals while allowing histamine to pass therethrough, said preliminary membrane being positioned before said analyte-concentrating membrane;

said analyte concentrating membrane comprises a membrane which will capture histamine such that the captured histamine may be subsequently eluted from the membrane; and,

said reagent comprises diamine oxidase and xylenol orange with acidified iron, for determination of histamine in said eluant-reagent admixture.

28. The system of Claim 19 wherein said first analyte is lipid peroxide and said second analyte is free fatty acids, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing lipid peroxides and free fatty acids to pass therethrough;

said second membrane is a membrane which captures lipid peroxides while allowing free fatty acids to pass therethrough;

said first reagent comprises xylenol orange, which when mixed with the filtrate in the first vessel will provide for determination of free fatty acids; and,

said second reagent is said reagent is selected from the group of reagents consisting of:

xylenol orange with acidified iron: and,

reduced hemoglobin;

said second reagent being combinable with the eluant in the second vessel to provide an eluant-reagent admixture from which lipid peroxides may be determined.

29. The system of Claim 19 wherein said first analyte is polyphenol and said second analyte is free fatty acid, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing polyphenols and free fatty acids to pass therethrough;

said second membrane is a membrane which captures polyphenols while allowing free fatty acids to pass therethrough;

said first reagent comprises xylenol orange, which when mixed with the filtrate in the first vessel will provide for determination of free fatty acids; and,

said second reagent comprises folin ciocalteau, which when mixed with the eluant in the second vessel will provide for determination of polyphenols therein; and,

30. The system of Claim 19 wherein said first analyte is polyphenol and said second analyte is lipid peroxides, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing lipid peroxides and free fatty acids to pass therethrough;

said second membrane is a membrane which captures lipid peroxides while allowing free fatty acids to pass therethrough;

said first reagent comprises folin ciocalteau, which when mixed with the filtrate in the first vessel will provide for determination of polyphenols therein; and,

said second reagent is said reagent is selected from the group of reagents consisting of:

xylenol orange with acidified iron: and,

reduced hemoglobin;

said second reagent being combinable with the eluant in the second vessel to provide an eluant-reagent admixture from which lipid peroxides may be determined.

31. The system of Claim 19 wherein said first analyte is all compounds having an unsaturated c=c bond and said second analyte is lipid peroxides, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing compounds having c=c bonds and lipid peroxides to pass therethrough;

said second membrane is a membrane which captures lipid peroxides while allowing other compounds having c=c bonds to pass therethrough;

said first reagent comprises iodide which when mixed with the filtrate in the first vessel will provide for determination of compounds having c=c bonds, and

said second reagent is said reagent is selected from the group of reagents consisting of:

xylenol orange with acidified iron: and,

reduced hemoglobin;

said second reagent being combinable with the eluant in the second vessel to provide an eluant-reagent admixture from which lipid peroxides may be determined.

32. The system of Claim 19 wherein said first analyte is all compounds having an unsaturated c=c bonds and said second analyte is malonaldehydes, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing compounds having c=c bonds and malonaldehydes to pass therethrough;

said second membrane is a membrane which captures lipid peroxides while allowing other compounds having c=c bonds to pass therethrough;

said first reagent comprises iodide, which when mixed with the filtrate in the first vessel will provide for determination of compounds having c=c bonds; and,

said second reagent is methyl indole which when combined with the eluant in the second vessel will provide an eluant-reagent admixture from which malonaldehydes may be determined.

33. The system of Claim 19 wherein said first analyte is lipid peroxide and said second analyte is histamine, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing polyphenols and lipid peroxides to pass therethrough;

said second membrane is a membrane which captures histamine while allowing lipid peroxides to pass therethrough;

said first reagent is said reagent is selected from the group of reagents consisting of:

xylenol orange with acidified iron: and,

reduced hemoglobin;

to provide a filtrate-reagent admixture from which lipid peroxides may be determined; and,

said second reagent comprises diamine oxidase and xylenol orange with acidified iron, for determination of histamine in said eluant-reagent admixture.

34. The system of Claim 19 wherein said first analyte is malondialdehydes and said second analyte is sulfite, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing malonaldehydes and sulfites to pass therethrough;

said system further comprises an intermediate membrane positioned between said first membrane and sad second membrane, said intermediate membrane being a membrane which will capture pigments and metals, while allowing malonaldehydes and sulfites to pass therethrough;

said second membrane is a membrane which captures malondialdehydes while allowing sulfites to pass therethrough;

said first reagent is xylenol orange with acidified iron to provide a reagent filtrate admixture from which sulfites may be determined; and,

said second reagent comprises methyl indole to provide a reagent eluant admixture from which malondialdehyde may be determined.

35. The system of Claim 19 wherein said first analyte is histadine and said second analyte is histamine, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing malonaldehydes and sulfites to pass therethrough;

said second membrane is a membrane which captures histamine while allowing histadine to pass therethrough;

said first reagent is tetrabromophenol blue to provide a reagent-filtrate admixture from which histadine may be determined; and,

said second reagent comprises diamine oxidase and xylenol orange with acidified iron, for determination of histamine in said eluant-reagent admixture.

36. The system of Claim 19 wherein said first analyte is all amines other than histamine and said second analyte is histamine, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing amines including histamine to pass therethrough;

said second membrane is a membrane which captures amines other than histamine while allowing histamine to pass therethrough;

said first reagent is diamine oxidase and xylenol orange with acidified iron to provide a reagent-filtrate admixture from which histamine may be determined; and,

said second reagent comprises xylidinyl blue, for determination of amines other than histamine in said eluant-reagent admixture.

37. The system of Claim 19 wherein said first analyte is aldehydes and said second analyte is bisulfites, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing amines including histamine to pass therethrough;

said second membrane is a membrane which captures aldehydes while allowing bisulfite to pass therethrough;

said first reagent is xylenol orange with acidified iron to provide a reagent-filtrate admixture from which sulfites may be determined; and,

said second reagent comprises methyl indole, for determination of malonaldehydes in said eluant-reagent admixture.

38. The system of Claim 19 wherein said first analyte is protein and said second analyte is aldehyde, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing proteins and aldehydes to pass therethrough;

said second membrane is a membrane which captures aldehydes while allowing proteins to pass therethrough;

said first reagent is Commaassie Blue to provide a reagent-filtrate admixture from which proteins may be determined; and,

said second reagent comprises methyl indole for determination of aldehydes in said eluant-reagent admixture.

39. The system of Claim 19 wherein said first analyte is polyphenols and said second analyte is lipid peroxides, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing proteins and aldehydes to pass therethrough;

said second membrane is a membrane which captures lipid peroxides while allowing polyphenols to pass therethrough;

said first reagent is 2,2-diphenyl-1-picryl hydrazine to provide a reagent-filtrate admixture from which polyphenols may be determined; and,

said second reagent comprises xylenol orange with acidified iron for determination of lipid peroxides in said eluant-reagent admixture.

40. The system of Claim 19 wherein said first analyte is polyphenols and said second analyte is free fatty acids, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing proteins and aldehydes to pass therethrough;

said second membrane is a membrane which captures free fatty acids while allowing polyphenols to pass therethrough;

said first reagent being selected from the group of reagents consisting of:

folin ciocalteau; and,

NH_3 with Fe^{++}

for determination of polyphenols in said eluant-reagent admixture; and,

said second reagent being xylenol orange to provide a reagent-filtrate admixture from which free fatty acids may be determined.

41. The system of Claim 19 wherein said first analyte is lipid peroxides and said second analyte is polyphenols, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing proteins and aldehydes to pass therethrough;

said second membrane is a membrane which captures polyphenols while allowing lipid peroxides to pass therethrough;

said first reagent is xylenol orage with acidified iron to provide a reagent-filtrate admixture from which lipid peroxides may be determined; and,

said second reagent comprises Prussian Blue in H_3PO_4 with EDTA for determination of polyphenols in said eluant-reagent admixture.

42. The system of Claim 18 wherein said analyte is procymidone, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing procymidone to pass therethrough; and,

said system further comprises a second membrane positioned after said first membrane, said second membrane being a membrane which removes pigments while allowing procymidone to pass therethrough; and,

said reagent is H_2O_2 and tetramethyl benzidine to provide a filtrate-reagent admixture from which procymidone may be determined.

43. The system of Claim 22 wherein said sub-detectable analyte is metals, and wherein:

said first membrane comprises microporous membrane which will prevent a portion of said matrix from passing therethrough, while allowing metals to pass therethrough; and,

said concentrating membrane is a membrane which captures metals; and

metals captured on the membrane are subsequently released from said membrane by an Fe^{+3} solution; and,

said reagent is xylenol orange to provide a flush solution-reagent admixture from which metals may be determined.

44. A method for determining histamine in a sample, said method comprising the steps of:

A. adding to the sample a reagent which causes histamine to oxidize with resultant production of H_2O_2; and, thereafter,

B. determining H_2O_2 in the sample as an indicator of histamine which was present prior to oxidation.

45. The method of Claim 44 wherein the reagent used to oxidize the histamine in step A is diamine oxidase.

46. The method of Claim 44 wherein the H_2O_2 is determined in step B by adding xylenol orange and acidified iron to the sample, and subsequently determining H_2O_2 based on the change in color of the xylenol orange.

47. The method of Claim 46 wherein the change in color of the xylenol orange is determined by a determination method selected from the group consisting of:

visual determination; and,

spectral determination.

48. The method of Claim 44 wherein steps A and B are carried out by adding diamine oxidase + xylenol orange + acidified iron to the sample.

49. The method of Claim 48 wherein the formulation of the diamine oxidase + xylenol orange + acidified iron comprises:

diamine oxidase.............1000IU

xylenol orange................0.1% by weight

acidified Fe^{++}..................1-10 m mol.

50. The method of Claim 48 wherein the diamine oxidase + xylenol orange + acidified iron is solubilized in a mixture of buffered water and isopropanol.

51. A method for determining free fatty acids in a sample, said method comprising the steps of:

A. adding a quantity of xylenol orange to the sample; and,

B. determining the change in color of the xylenol orange to indicate free fatty acids.

52. The method of Claim 51 wherein the xylenol orange is added to a concentration of between 0.1 % and 10.0 % by weight.

53. The method of Claim 51 wherein the xylenol orange is solubilized in water.

54. The method of Claim 51 wherein the xylenol orange is solubilized in isopropanal and water.

55. A method for determining free fatty acids in a sample, said method comprising the steps of:

A. adding a quantity of thymol blue to the sample; and,

B. determining the change in color of the thymol blue to indicate free fatty acids.

56. A method for determining lipid peroxides in a sample, said method comprising the steps of:

A. adding to the sample a quantity of hemoglobin and an activated electron donor substance, such that lipid peroxides present in the sample will cause at least some of the hemoglobin to convert to a modified hemoglobin derivative; and,

B. determining the amount of modified hemoglobin derivative present as an indication of lipid peroxides in the sample.

57. The method of Claim 56 wherein the activated electron donor substance in step A is acidified iron.

58. The method of Claim 56 wherein step B is carried out by visual determination of the change in color of the hemoglobin.

59. The method of Claim 56 wherein step B is carried out by spectral determination of the hemoglobin derivative.

60. The method of Claim 59 wherein said spectral determination is carried out at approximately 400 nanometers.

61. The method of Claim 56 wherein step A is carried out by adding to the sample a hemoglobin reagent having the formula:

hemoglobin............0.01-5.0 % by weight
iron........................2-20 m mol

62. The method of Claim 56 wherein step A is carried out by adding to the sample a hemoglobin reagent which contains 0.01-10.0 % by weight hemoglobin and 2-20 % by weight iron, in a buffered solution.

63. A method of determining sulfite and/or bisulfite in a sample, said method comprising the steps of:

A. adding a trivalent iron-xylenol orange complex to the sample; and,

B. determining the change in color of the trivalent iron-xylenol orange complex as an indicator of sulfite and/or bisulfite in the sample.

64. The method of Claim 63 wherein step B is carried out by a detection method selected from the group consisting of:

visual determination; and,

spectral determination.

65. The method of Claim 64 wherein the detection method is spectral and is carried out at 570 nanometers.

66. The method of Claim be wherein step A is carried out by adding to the sample a reagent containing 0.1-5.0 % by weight of Fe^{+3}(xanthine oxidase) in water/isopropanol solution.

67. The apparatus according to Claim 1 wherein at least some of the membrane modules are configured so as to nest within one another when stacked, thereby ensuring proper alignment of the membrane modules to allow sample to flow through each sample flow channel.